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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/014,355	12/14/2001	Hiroshi Aoto	35.C16022	1139

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EXAMINER

ANDERSON, MATTHEW A

ART UNIT PAPER NUMBER

1765

DATE MAILED: 10/16/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application N .

10/014,355

Applicant(s)

AOTO ET AL.

Examiner

Matthew A. Anderson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) 1-12 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 13-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4. 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group II claims 13-24 in Paper No. 7 is acknowledged. The traversal is on the ground(s) that there is no undue burden of examining the two groups of claims present in the application. This is not found persuasive because the differing issues that arise during the prosecution of the distinct statutory classes of invention pose a real and serious burden in examination.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 1-12 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected group I, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper No. 7.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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4. Claims 13- are rejected under 35 U.S.C. 103(a) as being unpatentable over Harmer et al.(US 6,048,394) in view of Lin et al. (Hexagonal-phase Retention in Pressureless-sintered Barium Titanate, Philosophical Magazine A, Vol. 8, No.1, pp.181-196, January 2001).

Harmer et al. discloses the method for growing single crystal from polycrystalline precursors. A seed crystal plate is bonded to a polycrystalline structure and annealed to form a single crystal as in Fig.1 (see abstract) The grown crystal has some in-grown porosity as seen in Fig. 9A. The specific perovskites named by Harmer et al. are the relaxors $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3$, [commonly known by the acronym PMN], $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_3$ or commonly PZN, and their solid solutions with PbTiO_3 or PT. BaTiO_3 is also described as subject to such grain boundary curvature driven grain growth in col. 1 lines 55-60 and col. 4 lines 33-40. The orientation of the seed was important and $\langle 100 \rangle$, $\langle 111 \rangle$, and $\langle 110 \rangle$ were described as possible growth directions. ($\langle 111 \rangle$, $\langle 110 \rangle$, $\langle 100 \rangle$ from fastest to slowest growth direction). Col. 4 lists result effective variable that affect the velocity of the grain boundary as the single crystal grows into the polycrystalline matrix. These are polycrystalline size, temperature, pore drag effects, and the presence of a liquid phase. The liquid phase was formed by deliberately adding a second component such as lead oxide, lead aluminate, etc which has a lower melting point than the major constituent (PMN-PT). Hot pressing was then possible from achieving low porosity. Annealing occurred then at 900-1200°C for up to 50 hours in a closed crucible. The heat (see col. 5 lines 1-5) causes the seed crystal to grow into the polycrystalline matrix under the influence of grain boundary curvature. A small amount of the wetting

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second phase is added in the matrix and around the seed crystal to enhance rapid growth of the single crystal. (see col. 5 lines 5-20. Lead oxide is disclosed as added in excess to cause a liquid phase and thus to promote the abnormal grain growth of the seed due to grain boundary curvature. Processing variables are disclosed in col. 2 and col. 3 lines 65+ and 1-5 respectively including grain size of the polycrystal, crystal orientation, interface chemistry, polycrystal chemistry, thermal gradient across the polycrystal/single crystal interface and processing variables.

Harmer does not explicitly specify a non-stoichiometric compact powder (i.e. one defined by $0.9800 < (\text{Ba} + \text{Pb}) / \text{Ti} < 1.0000$).

Lin et al. discloses the use of TiO_2 -rich barium titanate powder for sintering. The Ba/Ti ratio was given as 0.997 in Fig. 2. The TiO_2 rich barium titanate powder was known to give a bimodal grain distribution containing large plate-like grains (abstract).

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the references because Lin et al. gives a bimodal grain distribution with large plate-like grains which would have been known to have a large grain-boundary curvature as well as small grains. From Harmer, small grains and grain boundary curvature promote growth of the large single crystals (col. 4 lines 33-40).

It would have been obvious to one of ordinary skill in the art at the time of the present invention grow a single crystal from non-stoichiometric BaTiO_3 with PbO added while keeping the powder or member in a non-molten condition because Harmer et al. suggests such grain boundary curvature driven single crystal growth (col. 4 lines 33-40)

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and the addition of a wetting phase (col. 4 lines 45-55) for rapid growth (col. 5 lines 1-15).

In respect to claims 13-18, 23, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the amount of lead oxide added to BaTiO_3 powder to grow single crystals because such small amount of liquid phase in the solid phase matrix was described as hastening the single crystal growth and such optimization would have been achieved with only routine experimentation.

In respect to claim 19, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the temperature of sintering because Harmer et al. suggests 900-1200°C and because Harmer discloses the mobility of the grain boundary depends on temperature (col. 4 lines 30-35) and since such optimization would have been achieved with only routine experimentation.

In respect to claim 22, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the average grain size of the powder and the orientation of the seed because Harmer et al. suggests a lowered grain size for increased boundary mobility (col. 4 lines 33-40) and using an orientation $\langle 100 \rangle$, $\langle 111 \rangle$, or $\langle 110 \rangle$ seed crystal and such optimization would have been achieved with only routine experimentation.

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5. Claim 20, 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Harmer et al. and Lin et al. as applied to claims above, and further in view of Sakabe et al. (US 4,661,462).

Harmer et al. combined is described above.

Harmer et al. combined does not disclose the need for a Pb atmosphere.

Sakabe et al. discloses sintering of dielectric ceramic compositions containing lead in an atmosphere containing lead (col. 2 lines 15-30). The lead atmosphere is seen to prevent lead loss at high sintering temperatures.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the lead atmosphere of Sakabe et al. since this would have been seen to reduce lead loss.

In respect to claim 20 and 24, It would have been obvious to one of ordinary skill in the art at the time of the present invention to sinter a lead containing ceramic in a lead atmosphere because this would maintain a constant composition in the ceramic even at elevated temperatures.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claim 21 recites the limitation "...the lead atmosphere..." in lines 5 and 6. There is insufficient antecedent basis for this limitation in the claim.

Claim 21 does not depend on claim 20 and claim 13 has no recitation of Pb atmosphere.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (703) 308-0086. The examiner can normally be reached on M-Th, 6:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (703) 305-2667. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MAA
September 30, 2003

Matthew Anderson
A. U. 1765